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GREENEUM Global Energy Networks Whitepaper

November 1, 2017

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I would put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that.

— Thomas Edison

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ABSTRACT

GREENEUM is creating the most advanced network in the world to encourage the production, distribution, and consumption of GREEN , renewable, sustainable energy including solar, wind, hydro, and thermal.

The GREENEUM Network uniquely measures, verifies and incentivizes efficient and eco-friendly behavior throughout the entire supply chain to benefit present and future generations.

GREENEUM Global Energy Networks (GREENEUM) is designed to leverage targeted Artificial Intelligence (AI), blockchain technology, IoT and smart contracts. Our vision is to create and grow a decentralized and sustainable energy market that enables smart monetization for real time peer-to-peer (P2P) energy and data transactions.

Utility companies, grid operators, and users alike can obtain real time energy tracking while global trade markets will benefit from accurate and real time data. Integration of GREENEUM targeted AI and machine learning technology will enable a next generation of smart predictions, insights, and forecasts across the global energy market. Stakeholders in the energy ecosystem will be able to drive operational efficiencies, save millions and create a positive impact on the global renewable energy marketplace.

GREENEUM is characterized by a range of new technologies that are merging the physical, digital, and financial worlds challenging ideas about the essence of sustainable human co-existence on this planet.

The intent of this white paper is to create a compelling value proposition for GREENEUM and to understand the reasons behind GREENEUM's approach to the energy market as it relates to our global climate challenge.

1. Market Analysis and GREENEUM Solution

1.1. Pollution and Levels of Carbon Dioxide (CO2)

Energy demand is rapidly growing worldwide in reaction to population, transportation, and economic production changes. This demand surge creates increasing pollution levels of carbon dioxide (CO2) in the atmosphere and threatens our entire eco-systemic. The World Bank report claims that air pollution creates health repercussions and costs trillions of dollars annually[1].

Figure 1 shows the development of global CO2 emissions and CO2 concentration in the atmosphere. CO2 emission levels from fuel combustion have increased dramatically, reaching the highest concentration in history.

Main energy consumers in the private and public sectors, main energy could reduce emissions using more financial incentives related to smart energy control systems which utilize renewable energy sources.

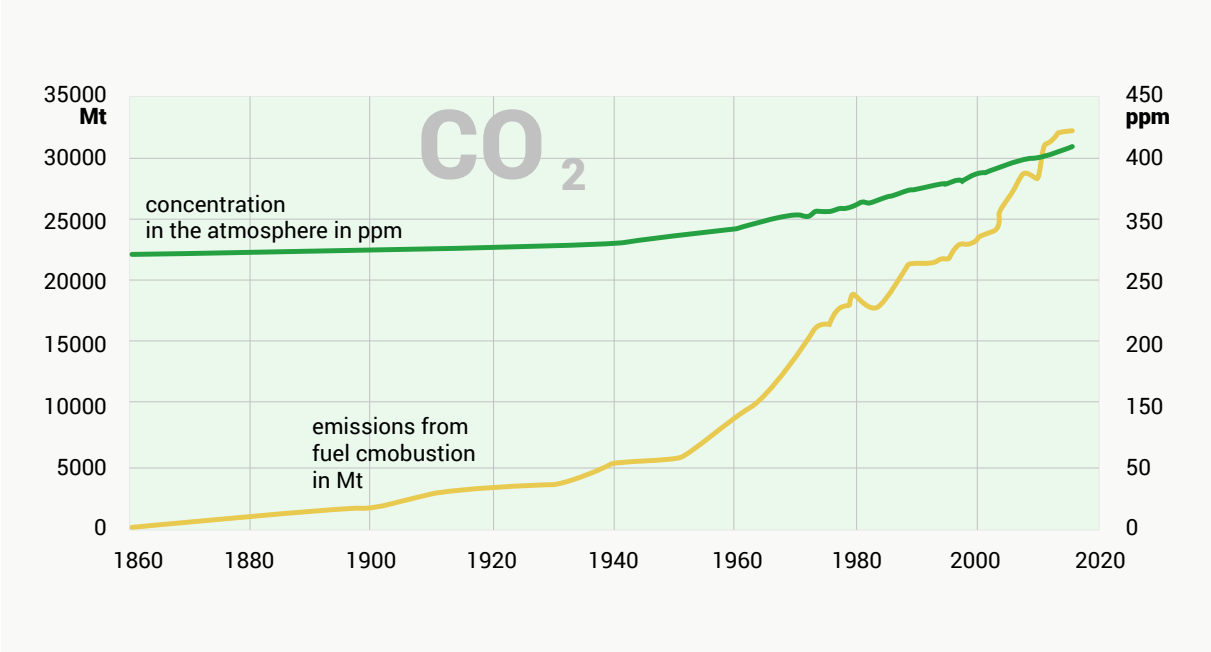

Figure 1: Global CO2 Growth from Fuel and Atmospheric Carbon Concentration.

1 http://time.com/4484027/air-pollution-economic-toll-world-bank/

Many solutions have been proposed in response to targeting the pollution challenge. These solutions make an effort to prevent, mitigate, and adapt to the climate change effects, but there is a tremendous amount of progress that we need to make.

The energy sector is responsible for a majority of the CO2 emissions worldwide. Market-based tools, such as the EU emission trading programs have required costly implementation efforts and long-debated updates. Incentive systems that aim to push companies and customers to reduce the consumption of nonrenewable energy often fall short of their goals, due to lack of binding targets and effective enforcement[2].

New and efficient technologies have arisen since since the inception of the 2016 Paris Agreement[3], giving us unprecedented capabilities to manage information and make more intelligent decisions. We face a unique opportunity as the energy sector endures structural challenges due to the EU liberalization of energy markets and shift to decentralized renewable energy.

Flashforward: GREENEUM for smart microgrids in emerging countries

GREENEUM's global blockchain design can be applied to transactions on local chains, used for physical energy trading and management services, within a local or micro grid where users are actually connected to each other through a private grid. These types of projects — will enable trading of energy certificates between users, particularly in areas with lighter regulatory burdens. These can also be implemented for energy trading platforms, energy supply chain and other various implementations, fostering the development of the energy sector in emerging countries.

Blockchain-based smart contracts, coupled with energy and environmental data management systems are the newest solutions to accelerate the transition towards a low carbon global economy. The next generation of the blockchain technology offers smart P2P valid interactions, smart contracts, IOT, targeted machine learning, and artificial intelligence algorithms[4].

2 http://www.business-review.eu/featured/GREEN -certificate-market-collapsing-89047
3 http://unfccc.int/paris_agreement/items/9485.php
4 https://medium.com/blockchain-4-0/about

1.2. Energy Market - Current State and Needs

Historically, a centralized approach has been used for energy production, transmission, distribution, and consumption. Utility companies, grid operators, infrastructure stakeholders on local and national level produce or purchase distributed and controlled energy. Users such as households and businesses have little, if any choice in this cycle.

Regulators and state agencies interface with these infrastructure agents to establish and regulate processes, service levels, and sometimes pricing, but this model lacks transparency with end consumers.

The energy market has remained mostly analog and highly commoditized. Service providers bring little added value for their users. Additionally, inefficient energy distribution and low resolution forecasting leads to large losses of potential revenue and inefficient transfer of energy. A significant portion of a consumer's energy bill is is attributed to transmission and administrative costs. Furthermore, energy trading, trading is limited to a known group of players that control the majority of the trade and distribution data.

Today, the energy has become a global issue. In the last decade though, renewable energy has gained momentum and legitimacy and it has reached a paradigm shift. It is also becoming more common that communities are voicing concerns related to governance, compliance, and transparency of the energy market.

According to the International Energy Agency (IEA) analysis (Figure 2) natural gas, fossil fuels, and nonrenewable sources of energy are still a major source of new energy generation. The IEA now says that renewable electricity will make up more than 20 percent of gross power generation in 2018, with non-hydro renewables accounting for 8 percent by that date. GREENEUM will accelerate the growth and facilitate greater efficiencies for the renewable energies integration into our core behavior. 2016 was a record year for solar in the United States. For the first time solar represented the largest new source of generating capacity, more than both natural gas and wind.

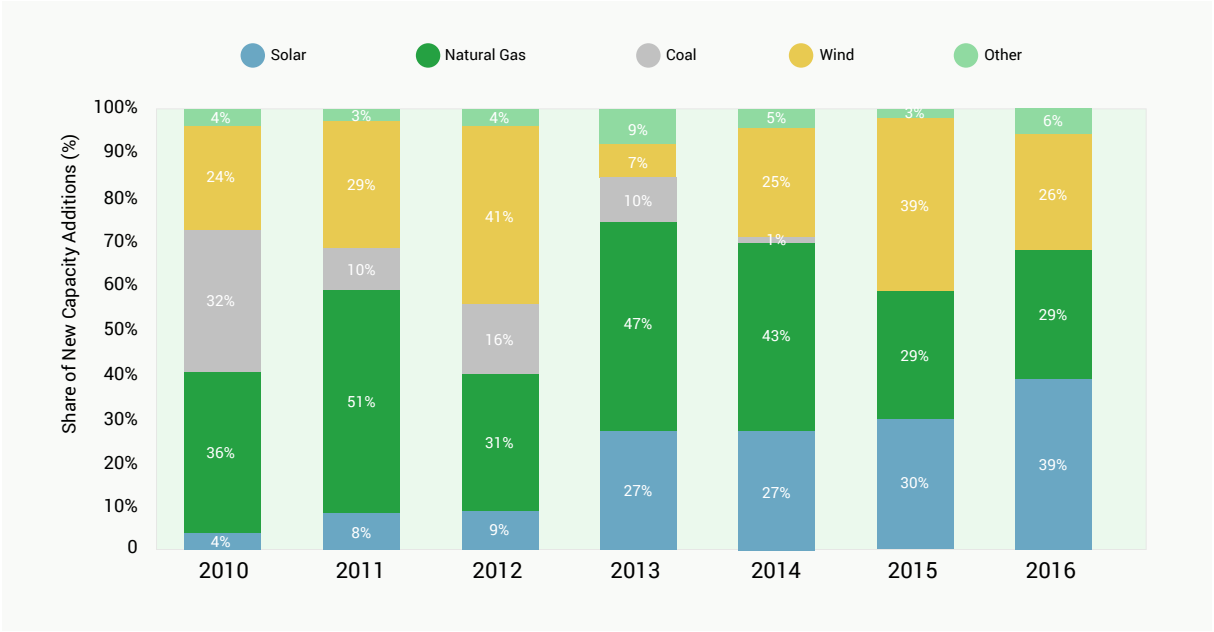

Figure 2: New US electricity generating capacity additions 2010-2016. [gtmresearch, SEIA report.]

Figure 3 shows the growth in renewable energy production per region, showing the highest areas of growth in China, North America and Europe. GREENEUM will focus on these regions while also creating outreach to grow the remainder of the world renewable energy markets.

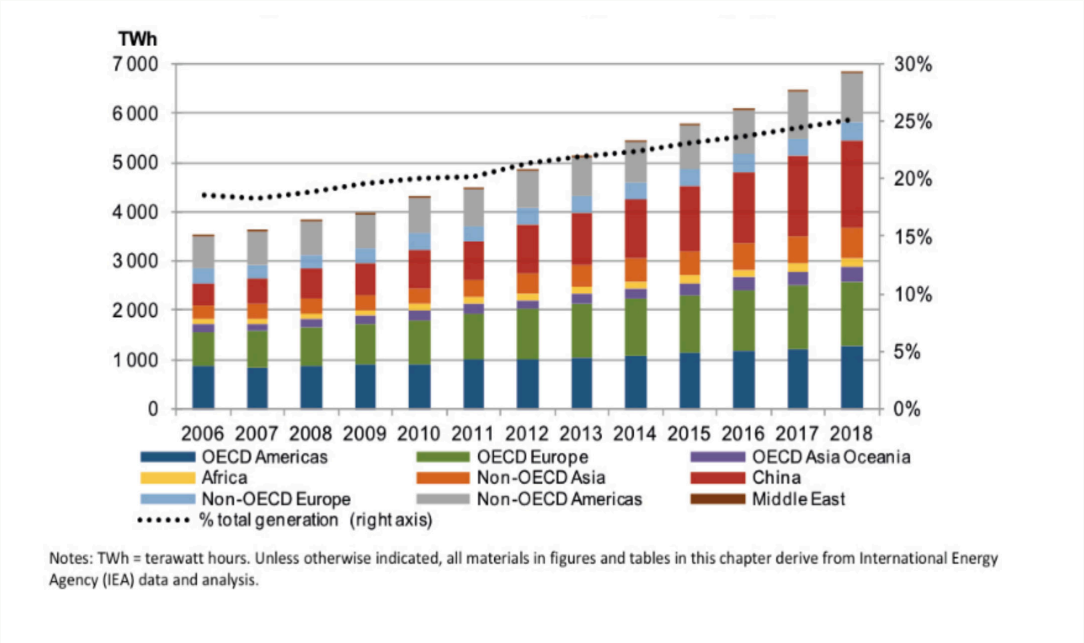

Figure 3: Global renewable electricity production per region (IEA, MTRMR, 2016)

Figure 4 shows the exponential growth of the US solar installations, utilities making up the largest portion with the residential market almost doubling every year. This is pushing the traditional players to reinvent their business models and search for new revenue streams throughout the whole energy ecosystem[5]. GREENEUM will seek to partner with both the centralized utility models and the decentralized residential solar providers to support the GREEN energy ecosystem.

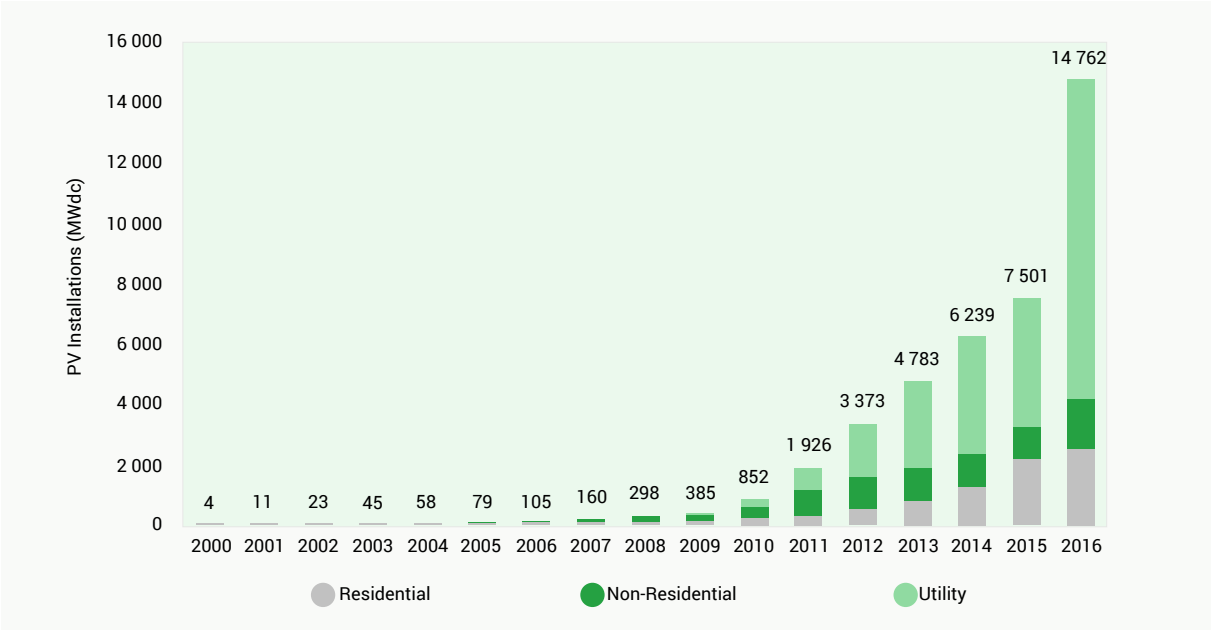

Figure 4: Annual US Solar installations 2000-2016 [gzmresearch, SEIA report].

1.3. Challenges and Needs in Energy Eco-system

1.3.1. Energy Prediction and Optimization

In order to reduce losses and optimize energy networks, smart analytics are needed. When it comes to predicting future energy production use there are few options in the energy marketplace. It is difficult for an energy producer to plan for the amount of daily energy use or get a reliable prediction of the amount of renewable energy that will be available. Spinning reserves are required to meet changing energy demands, and these reserves create inefficiencies in the energy generation and management[6]. The main problems in the energy marketplace regarding predictions and optimizations include:

5 https://www.navigant.com/-/media/www/site/insights/energy/2016/europes-energy-transition--take-control-of-your-fu.pdf

6 https://en.wikipedia.org/wiki/Operating_reserve

- Unreliable and inaccurate predictions of renewable energy production that result in large losses for energy grid operators and companies.

- Producers of renewable energy are unable to consistently produce at maximum capacity.

- Consumers pay the costs of inefficiencies through higher energy prices.

1.3.2. A Free Decentralized Energy Market

The energy market is undergoing a transformation from a centralized approach to a decentralized model. This transformation has occurred due to the need for sustainable energy sources and the growth of small distributed producers of renewable energy. Currently energy companies lack the holistic technology and the real time information that the GREENEUM network will provide. The current integration of the distributed production into the market for energy is insufficient [Forbes, 8,2016][7], creating large losses in all parts of the energy chain. The GREENEUM Network provides real-time renewable energy predictions and insights to the energy marketplace, allowing stakeholders to optimize their energy management.

1.3.3. Changing a Value Chain

The value chain for energy is split up in many ways through different entities. Each of these entities normally act in their own interests with little shared data and application to the greater system. Today, prior to a consumer using and being billed for their energy consumption, energy producers, utility distributors, local billing companies, meter reading and manufacturing services move or transact the consumer's energy. After the consumer is billed for power, there are often administrative entities and regulatory bodies involved during payment transactions. This system was created piecemealed over a long period of time to meet changing needs. Today however, this system as a whole is centralized and inefficient.

1.4. Developing Countries and Emerging Markets

For traditional centralized utilities and grid operators, blockchain implementation in the supply and consumer networks is useful, but not critical for the functioning of the system. However, in the emerging distributed energy economies, where assets at the grid edge interact with the grid and respond to near real time price events, blockchain technology can deliver three critical elements:

7 https://www.forbes.com/sites/pikeresearch/2016/09/13/energy-megatrends-part-8/

- Secure transactions

- Tracking and management of billions of micropayment transactions simultaneously

- Smart contracts with conditional functions for automating trade

The emerging markets pose additional challenges related to basic human needs. Even today, towards the end of the 21st century about 1.2 Billion of 7.6 Billion people on the planet do not have access to continuous energy supply and almost twice as many have do not have access to clean water[8] [9]. 15% of the world population is underprivlidged and cut off from the global modern economy and live in socio-economic gaps that often lead to conflicts, terror, and political instabilities.

The main applications for GREENEUM in emerging markets will be on-grid and off-grid renewable applications. The GREENEUM platform integrates any source of distributed energy and its smart contracts can be customized to the different market needs. This will enable energy management and trade in markets where these services are difficult to obtain or are unavailable.

8 https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS

9 https://www.theguardian.com/global-development-professionals-network/2015/jul/01/global-access-clean-water-sanitation-mapped

2. Greeneum Vision & Solution

GREENEUM is built using multi-chain architecture for management of global and local levels of monetization, data and energy. The platform consists of three parallel and connected systems:

1. GREENEUM Global Data system

2. GREENEUM Energy Trading system

3. GREEN Global Monetization System

The platform is built on blockchain and smart contract technology that is used to record (meta-data), validate and trade energy production and consumption. The P2P trading system will run on global public blockchain and will provide an opportunity for energy trading within and between electrical grids. The underlying data layer will be powered by proprietary AI and machine learning algorithms developed by the GREENEUM team.

The main building blocks of the two parallel systems that comprise the GREENEUM network are:

- **GREENEUM's AI/Machine learning algorithms** analyze and color energy transactions GREEN and non-GREEN certificates represent validated renewable energy data and available energy in the local grid. In addition, The GREENEUM AI platform provides insights and accurate predictions. This allows the balancing energy supply and demand and therefore results in the whole energy network (energy production, consumption, transmission distribution and storage) optimization.

- **GREENEUM's blockchain and smart contract technology** is used to record (meta-data), validate and trade energy production and consumption.

- **GREEN token**, a newly introduced cryptocurrency monetizing energy transactions, based on Ethereum (ERC20) GREENEUM token, GREEN , an ERC20 utility token, will be used for monetization of the GREENEUM Network. The utility token is a tool to incentivise the energy ecosystem towards a more efficient, profitable, and GREEN behavior.

Vision 2030: Financial Incentives to GREEN behavior

GREENEUM's network will enable the crypto community, large energy companies,

and power consumers the opportunity to set voluntary individual climate targets and KPI's. These will be translated into GREEN quotas to be met each year. These quotas will be validated only through targeted AI and automated smart contracts.

GREENEUM tokens power the network, a general outline of the GREENEUM network is depicted in **Figure 5**. A full detail of the different entities definitions, roles and inter-and-intra relations will be detailed in future publications.

GREENEUM's global blockchain is used for GREENEUM transactions. Local chains (which can be customized to be semi-private) are used for the energy trading and management services within a local or micro grid. Interchain contacts will enable the trading of energy certificates between grids and networks, these can also be implemented for energy trading platforms, energy supply chain and other various implementations. Access to the GREENEUM network, trading data, and energy is accomplished through GREENEUM global monetization layer using the GREENEUM ERC20 utility token called **GREEN**[10] .

The eco-system contains interactions between the Global Data Market Network (Data Trading System) and Global and Regional Energy Networks (Energy Trading System).

10 https://theethereum.wiki/w/index.php/ERC20_Token_Standard

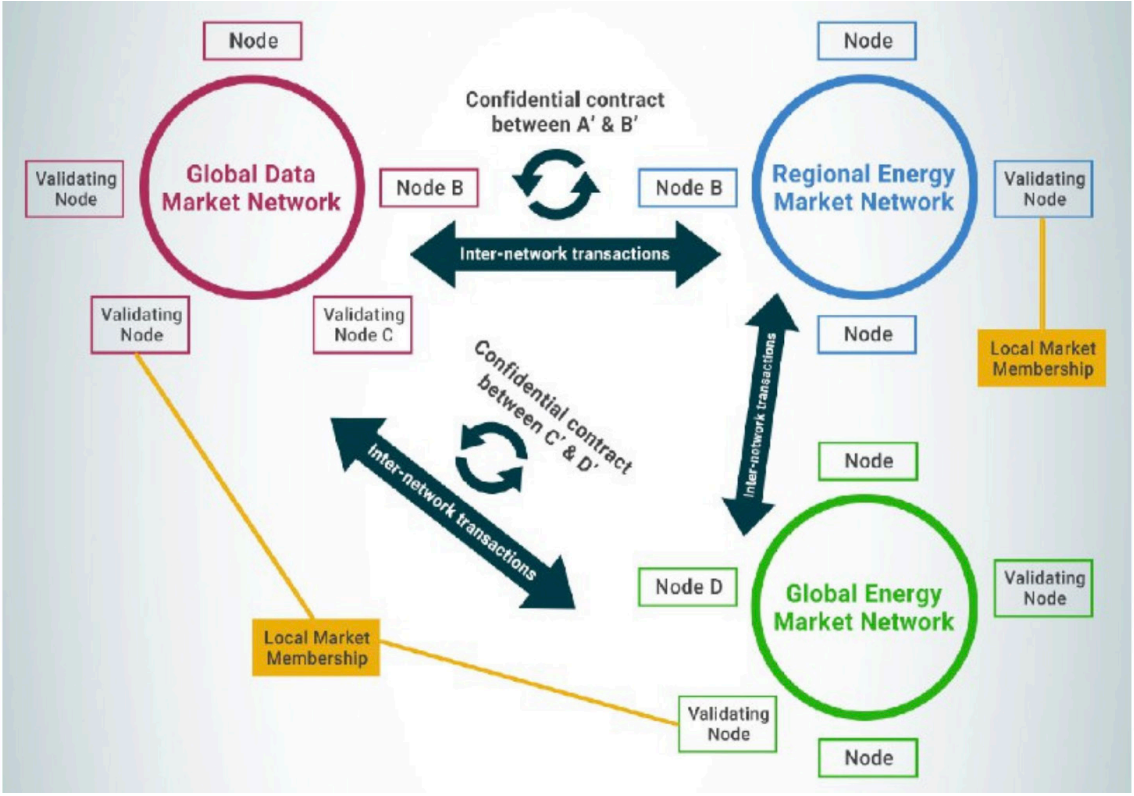

Figure 5: Schematic overview of the GREENEUM decentralized multi-chain network.

GREENEUM connects the energy industry via a peer-to-peer network, enabling a win-win solution for the energy marketplace. Our solution allows producers, consumers, utilities, grid operators, and energy traders to connect and optimize their performance. The GREEN token represents a unit of value for energy transactions; furthermore, it is an Ethereum based token that utilizes smart contracts and network AI.

ERC20 utility token system will enable secure, transparent, auditable, and efficient digital interactions that are highly resistant to outages. These advantages will be utilized to create a decentralized, secure, and more efficient marketplace for energy production. The process can be scaled up globally while maintaining reliability and compliance with regulatory interests.

Reinventing the wheel?

Tradeable guarantees have existed as a concept for a while now. Artificial markets for tradable GREEN certificates have been established in many countries. This requires energy utilities to meet specific quotas of GREEN power in order to avoid fines or other penalties[11].

11 https://www.epa.gov/GREEN power/us-renewable-electricity-market

Due to the experimental nature of such initiatives, in a time where binding climate targets were more of a “nice to have” statement on political agendas than a “must have” tool. Enforcing mechanisms were often weak, the quotas subject to changes and the transaction costs (registration, validation, administrative fees) comparatively very high. GREENEUM makes energy markets more efficient and profitable, rewarding in GREEN tokens all of us to ‘Go GREEN ’.

Together, the GREENEUM network and blockchain technology will serve as a medium and path to exchange energy, data and insights. Additional applications will be created in the future to grow the network such as different types of predictive analysis (e.g. weather patterns that impact renewable energy production, energy consumption), energy social network ecosystems, and interactive mobile application.

GREENEUM creates a free global energy market, where all energy stakeholders can trade with each other and incentivize GREEN production.

2.1. The GREENEUM Energy Trading System

Energy Trading on the GREENEUM system takes place on the electrical grid as well as the GREENEUM blockchain network. Electrical data is transmitted through a validation process, where the energy is profiled and verified. The system runs periodic calculations of production and consumption on the grid and allows consumers to interact directly with each other. Producers of GREEN energy are rewarded with GREEN certificates and GREENEUM tokens. Consumers use GREENEUM colored tokens (GREEN certificates) for energy consumption. They buy them from the producers and accumulate GREENEUM Carbon Credits for their consumption of GREEN energy.

2.2. The GREENEUM Global Data System

The data system is global and operates on the GREENEUM blockchain network. The system records validations on the blockchain. The validated data goes to AI processing to generate predictions and insights. If a producer of GREEN energy that sends valid data to the system, they will receive a GREEN Certificate for the clean energy production. GREEN certificates can be used to convert to GREENEUM tokens in the GREENEUM Energy Trading System. Carbon Credits and GREEN Certificates will be validated, monetized, and globally traded.

The GREENEUM Energy platform is a complete solution for the current and future energy market. This solution effects the full spectrum of producers from consumers with a solar panel based on a single rooftop to global scale production models.

GREENEUM Blockchain connects all players into a global shared network, where

energy data is reliably recorded and anonymously stored. Energy production is validated and profiled.

GREENEUM AI and machine learning technology runs statistical analysis of data and produces smart insights and accurate future predictions. Predictions are then used for optimization of the energy distribution.

3. GREENEUM NETWORK ECOSYSTEM

GREENEUM Network includes a global blockchain for verifying data, a marketplace for GREEN certificates and another for data storage, as well as an ERC20 token for monetization.

3.1. Definition of Terms

GREENEUM Token (GREEN): GREENEUM ERC20 utility token called GREEN is an ethereum token used as the network token. GREEN is used for a global monetization of the GREENEUM Energy Trading and the GREENEUM Global Data Systems.

GREENEUM Ecosystem: System of users, providers, consumers and any other entity interacting with the GREENEUM Network.

GREENEUM Energy Network: An energy network is a system that utilizes energy effectively by controlling a large number of energy supply and demand facilities of various types by using a communication network.

GREENEUM Foundation: Foundation to assist in the continuous development and growth of the GREENEUM Ecosystem, funded through the GREENEUM token.

GREENEUM Network: Is the GREENEUM Blockchain network.

GREENEUM Certificate: GREENEUM certificates are tokens which are issued by the system after produced energy is validated as GREEN or non GREEN . They describe the energy source, amount and corresponding GREENEUM Carbon Credits. In the energy trading flow they are sold to the consumers, who are granted with the carbon credits. In the data flow they are given to the producers and they can sell them freely on the global market. The certificates can be used for balancing supply and demand and for energy management of electrical grids.

Table 1: Features and Incentives for stakeholders Segments.

Segment	GREENEUM Feature	Incentive
Energy Consumer	Energy Trading Market	Lower prices: Save management and other middleman costs
	GREEN Certificates Market	Financial reward, encourage GREEN energy production
	Energy Data Market	GREENEUM data bounty
	Energy management tool	Lower prices: Consume energy more efficiently, rewarding smart energy consumption of energy.
Energy Producer	Energy Trading Market	Higher prices with less management and other middleman costs
	Energy Data Market	GREENEUM data bounty
	GREEN Certificates Market	GREENEUM Certificates that are traded on the market
	Energy management tool and predictive weather	Produce and predict energy production more efficiently

Segment	GREENEUM Feature	Incentive
Electric power distribution/ Utility / Power Company	Sell Energy	Lower administrative costs Improved consumer experience
	Distribute Energy	GREENEUM Service and Distribution Fees on every transaction on the grid Utilize distribution network Access to more decentralized energy producers on existing distribution network
	Purchase predictions and insights	More efficient prediction on energy needs for plant operation
Grid Operators	Energy management tool and predictive weather	More efficient prediction and balanced energy loads

Segment	GREENEUM Feature	Incentive
Government and NGO	Data on Clean energy production and consumption	Higher efficiencies on data acquisition
	Data on Energy availability	Safer and more balanced energy network
	More open trade and data network creates self-regulating marketplace	Ensure consumer protections with fewer need for regulation
Data Traders	Energy Data Market	Trade Data and GREEN Tokens
Energy Traders	GREEN Certificates Market	Trade Certificates and GREEN Tokens
	Energy Trading Market	Trade Energy and GREEN Tokens

3.2. Ecosystem member functions

Producers - In the GREENEUM energy trading system, energy producers are nodes on the network, this includes major and national energy suppliers as well as private households and farms. All nodes are equal players.

Consumers - Consumers consume electricity, they connect with the validators and producers to receive power and verification of the source of the energy they consume. Prosumers are producers which are also consumers of energy.

Validators - Validator nodes are any nodes on the Blockchain, executing the

computational process of the energy transaction validation. The validation procedure includes profiling the energy source to be GREEN , as well as validating the energy amount.

Grid Operators - A transmission system operator (TSO) is an entity entrusted with transporting electrical power on a national or regional level, using fixed infrastructure. The term is defined by the European Commission. TSO is an operator that transmits electrical power from generation plants over the electrical grid to regional or local electricity distribution operators.

Electric Power Distribution (Utility) - Electric power distribution is the final stage in the delivery of electric power; furthermore, it carries electricity from the transmission system to individual consumers. Distribution substations connect to the transmission system and lower the transmission voltage to medium voltage ranging between 2 kV and 35 kV with the use of transformers. In some cases, the grid utility may also be an energy producer. Utilities also work with grid operators and other types of utilities.

Energy Traders - Energy traders trade capital and energy on markets based on supply and demand. They are also able to purchase or utilize insight and predictions.

Data Sharers - Energy Producers, consumers or entities from the energy market can send energy data to the network even if they are not trading energy via the GREENEUM Network. They get GREENEUM token bounty for the shared data and certificates. The shared data is open to the Network and is used by GREENEUM AI.

Data Traders - Are buying validated or unvalidated energy related data via the GREENEUM Network. They could also serve as validators of the data.

GREENEUM Market - Another function in the system includes any buyers of certificates, of predictions and energy management system. They are all referred to as “Market”.

Any entity can also be more than one member in the network (validators can be energy traders, consumers can be producers, etc.).

4. GREENEUM NETWORK TRANSACTIONS

4.1. Network Main Layers

GREENEUM is an efficient multi-chain energy network which solves the problem of inefficient blockchain transaction computation using a main three-level structure solution:

4.1.1. Monetization Layer

The first face and solid foundation in the solution architecture. Ethereum blockchain technology powers the underlying logic that simplifies the complex process and is a popular platform for a multitude of diverse cryptocurrency applications. Ethereum is a framework that fits GREENEUM because of its large active network, widespread adoption, fluid token compliant protocols, and versatility in smart contract programming.

Additionally, Ethereum quickly adapts and evolves in the blockchain ecosystem to ensure security and authenticity with Casper. Casper provides proof-of-stake consensus mechanism to validator and verifier nodes in the network. The idea is migration from cumbersome proof-of-work over to validation and verification while keeping and enhancing the authentication through security deposits along the ethereum blockchain.

4.1.2. Data Layer

GREENEUM data collection, validation, verification and AI assures that all energy is securely digitized. This is the secondary level in the architecture solution and is a precious resource because it possesses great potential value by unlocking access to eco-informatics, knowledge banking and engineering. The high tech world, where we witness increasing interconnectedness between billions of humans and IoT (i.e. “Internet of Things”) smart devices and inundates information systems with explosive data analyticsis the digital equivalent of acquiring oil, soil, silver and gold. GREENEUM, in addition to acting as an energy monetization network, is also acts as decentralized data trading ecosystem with IoT integration which further rewards energy generated analytics.

4.1.3. Certificate Layer, New Green Energy Proof Mechanisms

Tertiary level that introduces our unique consensus concept “Proof of Energy” and “Proof of GREEN”. Proof of Energy and Proof of GREEN open up creative opportunities worldwide for the blockchain, energy and financial markets.As a new proof mechanism we intend to incorporate delegation. The delegation consensus model requires an explanation described briefly below when proof systems are introduced. The idea is to include the validators and a monetization mechanism ecosystem.

- **Proof of Energy** - a digital service designed to anonymously & securely store a digital distributed Proof of Energy for any kind of transaction along the multi-layer energy supply chain including type, quantity, direction, time and location.

- **Proof of GREEN** - a validation service designed to anonymously and securely store a quantified digital distributed proof of GREEN Energy, for any kind of energy transaction along the energy supply chain.

- **GREEN Energy** - energy that is collected from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, geothermal heat, etc. GREEN energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services.

4.1.4. Energy usage for blockchain

Currently the state of affairs within the blockchain industry is dedicating a tremendous effort to solving a computational game that consumes prodigious energy spending, all in the goal of reaching cooperative consensus (i.e. “proof”) among nodes in the network. The dilemma leads blockchain-based companies to desire much more efficient and cleverly designed consensus protocols in order to justify a fair reward for the hard work and time investment which all honest participants deserve.

At the heart of GREENEUM is a revolutionary renewable energy trading model which is decentralized, distributed and democratic energy access that gives control back in the hands of hardworking contributors who add value in the network.
It is a new opportunity to financially incentivize and empower ecologically and economically-friendly businesses, clean energy producers, traders, consumers and investors while saving costs, time and the natural environment all at once. There are over 2 billion people on earth that are unpowered and underprivileged, GREENEUM creates the possibility for them to access smart, clean, and renewable energy they need to survive in their communities.

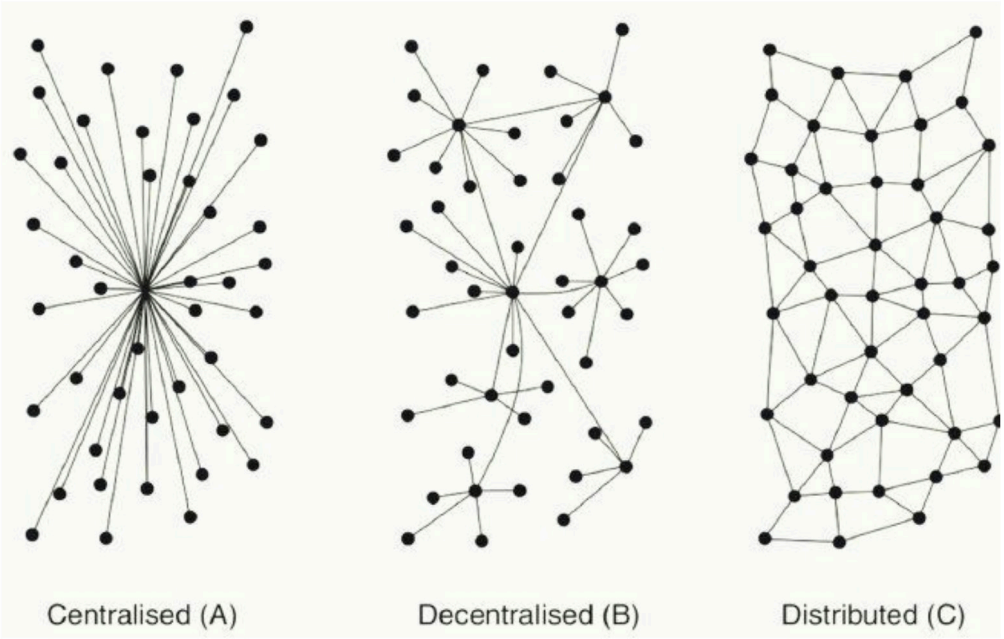

Figure 6: Diagram Describing Network Differences[12]

Albert Einstein immutably changed our world when he discovered the energy equivalence law stating mass creation as a product of matter (m) and the squared speed of light (c2)[13] :

$$E = mc^2 \quad (1)$$

GREENEUM likewise is a light leading the change in our world's future of equitable, effective energy access through value creation for humanity in the tangible form of a massively interwoven network fabric, a network which has a potential squared speed of polynomial growth on the orders of the exascale and beyond in form of:

$$G = MWh * c.f^2 \quad (2)$$

where c.f stands for control function (e.g.n=#nodes in the network, Metcalfe's law.) and MWh is the amount of energy involved in the transaction. This principle is the basis for GREENEUM monetization function of energy transactions.

12 https://medium.com/@VitalikButerin/the-meaning-of-decentralization-a0c92b76a274
13 https://plato.stanford.edu/entries/equivME/

4.2. GREENEUM Consensus Protocols

Among each layer of abstraction from GREENEUM's revolutionary architecture, the consensus proof algorithms work diligently behind the scenes and are important and largely responsible for determining network efficiency for the carbon flow of computation. As mentioned before, the Proof-of-Work is an optimistic start. But solving the puzzles that Proof-of-Work involves scaling issues and transaction processing bottlenecks. Among each layer of abstraction from GREENEUM's revolutionary architecture, the consensus proof algorithms work diligently behind the scenes and are important and largely responsible for determining network efficiency for the carbon flow of computation.

4.2.1. Proof-of-Stake Consensus Model

Implementing an alternative mechanism, such as **Proof-of-Stake**, saves massive loads of energy consumption and migrates from meritocracy-based work model to an modern equity model similar to ownership rights by wealth and age. In fact, by entering time factor into the equation Proof-of-Stake we create PoST (Proof-of-Stake-Time.) It is said that Bitcoin mining could consume as much electricity as Denmark, or at least enough to power a small town, depending on the rate of network size growth rate and type of consensus model. PoST blockchain securitization is an efficient low carbon footprint process that helps save electricity usage by 97-99% than compared to simple Proof-of-Work alone.

GREENEUM's long term road map is to build a Data Layer in the architecture to incorporate the Proof-of-Stake consensus model — because it requires a complicated validation mechanism which is solved by AI. Then the IoT integration with the Data Layer would incorporate the delegation process along with the time component for a Proof-of-Stake-Time consensus model. The stakeholders in the market are a vital part for the validation of the architecture solution design who help save time and distribute rewards.

4.2.2. Delegated Proof-of-Stake protocol (DPoS)

Certificate Layer in the long term goal requires delegated Proof-of-Stake protocol (DPoS). GREENEUM NET is a multi-ledger with a variety of GREEN certificates that need to undergo a process of certification, validation and verification nodes in the network. Delegation ensures that the highest quality of decentralization is upheld by supervision from a voting ballot known as a witness panel who see that stakeholders do not gain and take over control of the entire network for their own personal interest. Certificates in the network nodes ecosystem are therefore guaranteed to represent more credibility and authenticity as a result of the delegation protocol.

If the energy was fed into the shared system of power lines which transport energy the GC provides a mechanism for the purchase of renewable energy that is added to and pulled from the electrical grid. This internal token allows utilities, grid operators and micro-grids to monetize energy transactions securely, allow B2B and peer to peer trading in a semi-public chain.

At the same time GREENEUM AI algorithms are used to optimize all electricity transactions GREEN (and non-GREEN). Stakeholder from the energy space could use the GREENEUM energy platform for different energy related financial services and payments.

The GREENEUM validation procedure is performed as described in the figure below. In the first step the producer uploads his production data to the platform for validation. The validation is performed by the GREENEUM AI unit or data validators/traders. After the validation is approved GREENEUM GREEN or **non-GREEN** certificates (**GC** or **NGC**) are issued to the producer of **GREEN** energy (1 GC = 1 MWh). Verified certificates are equivalent to the amount of available energy in a specific grid, where GREEN certificates are associated with clean production from renewable energy resources (for on-grid applications other certificates are issued for contributions of non renewable energy to the grid). The holder of the GREEN certificate can trade them or use them for getting Carbon Credits by consuming the certificate.

Consuming smart contract can be done only once to each certificate and can not be reputable and is published to the blockchain. A consumed certificate is uncolored and goes back to the platform/cloud. The payment for the electricity is done using the GREENEUM token. The consumer is accumulating carbon credits if the certificates represent clean energy. Accumulation of carbon credits provides a good reputation in the GREENEUM network and different benefits both to companies/ organizations and private users.

4.3. GREENEUM Global Data system

The GREENEUM data system is a global system which does not involve the local electrical grid or utilities. The GREENEUM Data Bounties are rewards granted to any entity on the Blockchain in return for sending data for validation. It consist of the following elements:

- GREENEUM Certificate are granted to a producer of validated GREEN energy.
- GREENEUM Carbon Credits is a system of calculations of each member based on GREEN energy data.

- GREENEUM Data Bounty - are bounties given to any member sending electrical valid data to the GREENEUM Network.

4.3.1. GREENEUM Certificates

GREENEUM Data bounties are used to incentivize data sharing within the network. GREENEUM Certificates (GC) are internal tokens of the platform which are used to tokenize all types of energy transactions. GREENEUM Certificates can be GREEN and non GREEN , represent the amount of energy produced and ultimately have two states: unconsumed and consumed. The certificates represent two states of energy and their analogy represents the poles/sides of the energetic system (similar to holes and electrons in solid state physics modelling).

GREENEUM Certificates can be traded within the network. GGC and NGC would trade similar to the U.S. Renewable Electricity Certificates (REC), or Tradable Renewable Certificates (TRCs). GREENEUM Certificates are non-tangible energy commodities in the GREENEUM platform that represent proof that electricity was generated from an eligible renewable energy resource.

GREENEUM provides additional incontrovertible proof by adding smart contracts and targeted AI to effectively identify and verify GREEN energy. The team created a brand new consensus protocol called Proof of GREEN , where renewable energy production can be created, tracked, labeled, traded and monitored globally. Consumers, companies and users alike can purchase GREEN Certificates from the renewable energy producers to reduce their carbon footprint. Producers can receive a reward for GREEN energy production.

In **Figure 7** below the entire lifecycle of a GREEN certificate is depicted. A GREEN certificate is created (step 2) upon a confirmed validation (step 1) of creation of GREEN energy. The GREEN certificate is given to the producer (step 3). The producer can trade the certificate for GREEN tokens (step 4) and finally, an owner of the certificate can consume it and receive carbon credits (step 5). The lifecycle of the gray (non-GREEN energy) certificate is similar, without the final consumption step (step 5).

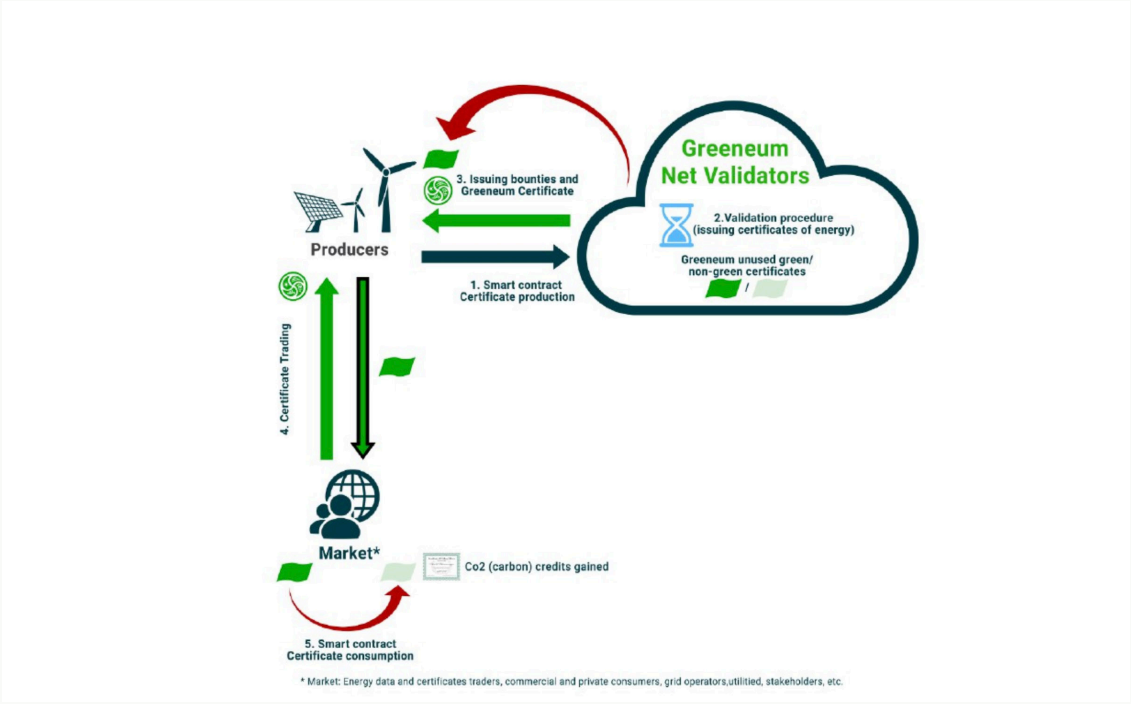

Figure 7: Used and unused GREENEUM Certificate (GC) flow diagram.

4.3.2 GREENEUM NET AI

The GREENEUM Net AI contains services which are offered to the GREENEUM platform users. GREENEUM is integrating and developing a unique AI technology (**Figure 8**) which has been tested in small pilots and will be deployed in solar commercial and residential energy projects.

Further technical details of the GREENEUM NET AI and the validation algorithms and predictions will be elaborated at the next technical and scientific yellow paper, a brief high level overview of the NET AI is described below.

AI and Machine Learning are used to predict energy production and consumption patterns. In this model producers of energy are able to purchase intelligent analytics pertaining to energy usage. Producers and consumers can use the energy management tool to optimize their consumption behaviour.

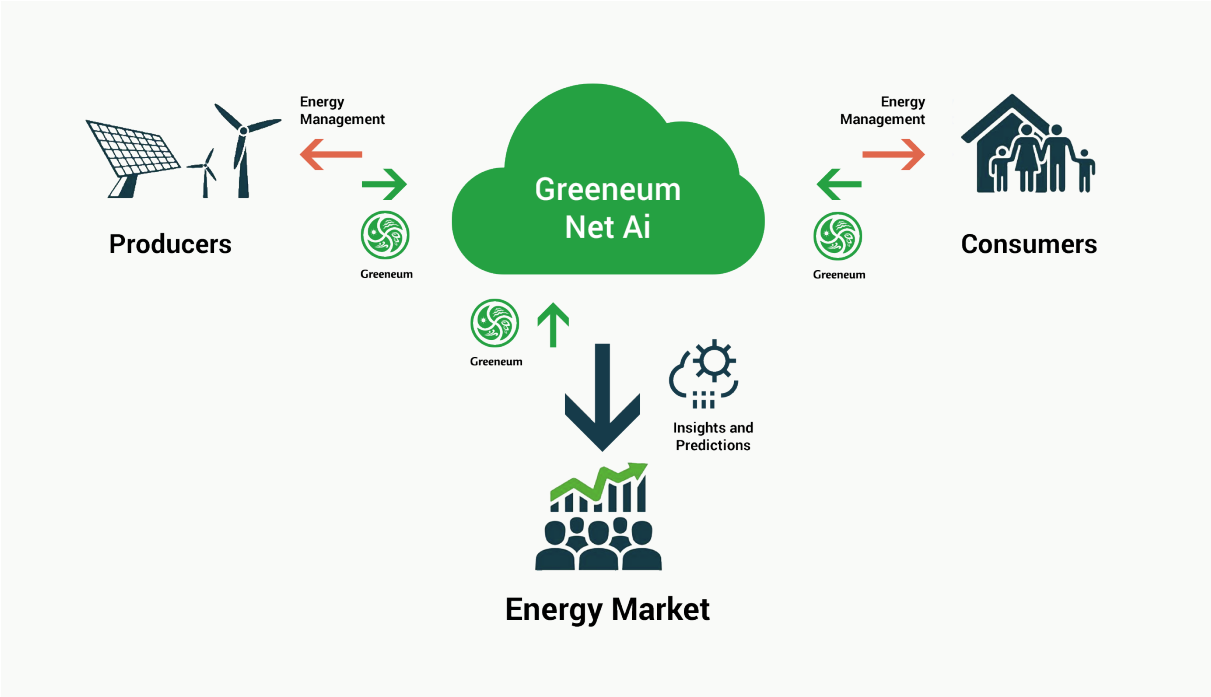

Figure 8: General flow diagram of GREENEUM AI.

GREEN token holders are able purchase additional AI and energy management services, this process allows for a greater balance of supply and demand to optimize energy assets and electricity networks. GREENEUM will develop interfaces for external AI providers to improve energy management and network efficiency.

An example of solar energy prediction is shown in **Figure 9**. The GREENEUM AI Algorithm can yield above 95% accuracy without the need for any radiation maps, instead using skymaps and sophisticated machine learning algorithms. These algorithms are based on statistical models allowing energy validation and prediction for a typical producer and consumer. Additional information about the algorithm will be published in the technical report and media channels.

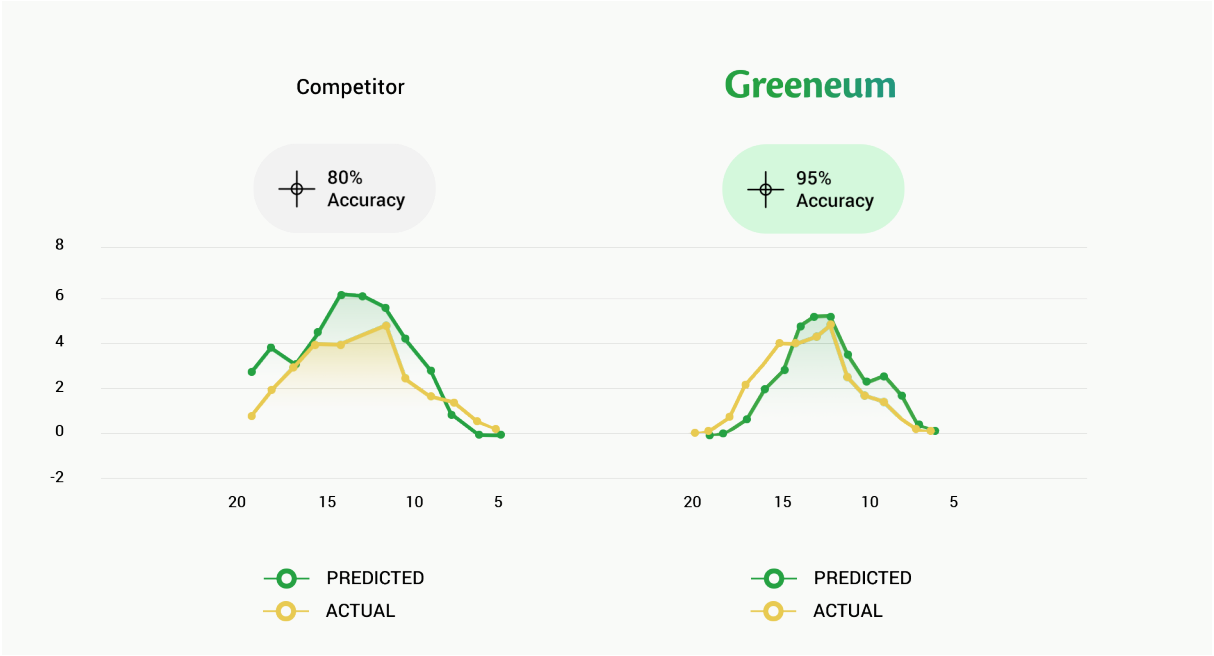

Figure 9: Comparison between a competitor (left) and GREENEUM predictions algorithm for solar energy production. An accuracy of above 95% is achieved using GREENEUM patented and verified algorithms.

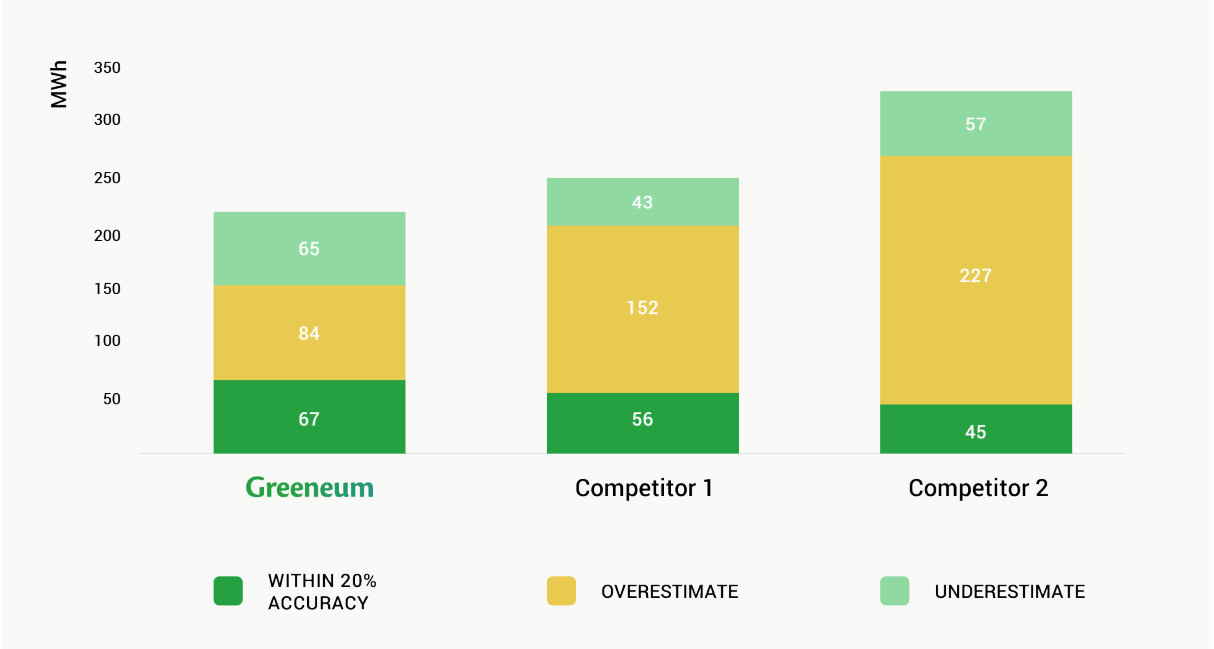

Figure 10: Comparison of GREENEUM energy forecasting algorithm compared to state of the art technologies in the market.

4.3.3. Personal Energy Management

GREENEUM's machine learning algorithms, together with the network signals and nodes are used for optimization. Energy producers can use these features to optimize their energy and storage management to increase assets efficiencies. By sharing their consumption data, energy consumers are capable of automating their energy management and receive advice on how to reduce their consumption. Some of these services will be included as premium services on the GREENEUM Platform and will only be purchased with GREENEUM token, increasing its demand.

4.3.4. Grid Optimization

GREENEUM's machine learning algorithms serve not only to perform validation of the recorded data based on history and local surrounding statistics. The main result of GREENEUM Network data processing is to generate accurate predictions about the supply and demand on the electrical grid as well as other grid parameters and KPI's. Enabling every grid component to be optimized.

4.4. GREENEUM Energy Trading system*

In the GREENEUM energy trading system, all energy producers can be nodes on the network, this includes major and national energy suppliers and private households. All nodes are equal players while transmitting energy and receiving GREENEUM payment.

The grid operator and/or utility company enables transportation and distribution of the electricity on the grid; In addition, it may or may not serve as an energy producer.

Validator nodes are any nodes on the Blockchain that execute the validation of the energy production. The validation includes profiling whether the energy source is GREEN , as well as validating the energy amount.

The contract for participating in GREENEUM Energy Trading is signed between the producer and consumer. GREEN energy producers are able to receive incentives for producing validated GREEN energy. The producers and grid operators receive transaction fees on every transaction on the grid for supporting the process and allowing the distribution of electricity. Transaction fees are built into the energy pricing on the market.

The energy-token consumption and production flow diagrams are depicted in **Figure 11** below and shows the energy trading model. In this network, the Producers/Prosumers can produce energy that is verified through the GREENEUM network distributed AI algorithm. The price for different types of energy is determined by the market conditions (demand and supply, weather, etc.). On the other side of the network are the consumers who are able to trade GREENEUM for energy and receive GREEN Certificates and carbon credits. GREENEUM Certificates are used to label energy transactions, accumulate carbon credits and to track available (GREEN and non-GREEN) energy in a physical grid.

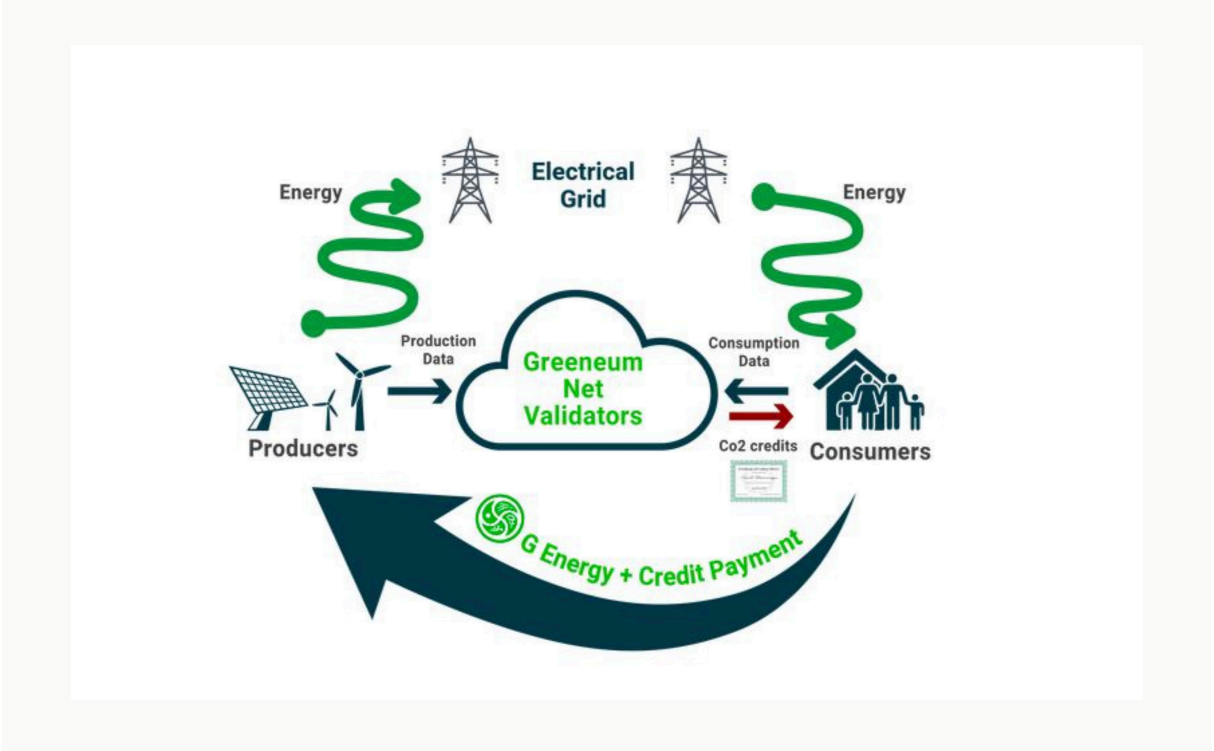

Figure 11: General outline of GREENEUM energy trading flow.

4.4.1. Rewarding NegaWatts

Consumers will be rewarded for saving energy (negative energy). That will be help to optimize energy network and reduce/increase consumption according to the available energy in the network. The amount of GREEN reward per NegaWatt will be proportional to the amount of energy which was saved.

4.4.2. P2P Energy Payment System

Energy trading takes place on the electrical grid. Periodic calculations of the production and consumption conclude the amount generated by GREENEUM users as well as the amount consumed by GREENEUM users, and a split of payment is generated. GREENEUM tokens are being transferred directly from the consumer's GREENEUM wallet to the Producers GREENEUM wallets, according to that split.

The utility acts as a producer in the case where the energy consumption of GREENEUM consumers was higher than production, and as a consumer vice versa. The GREENEUM tokens are bought from the GREENEUM token holders by the consumers. This can be done through an automatic backend exchange.

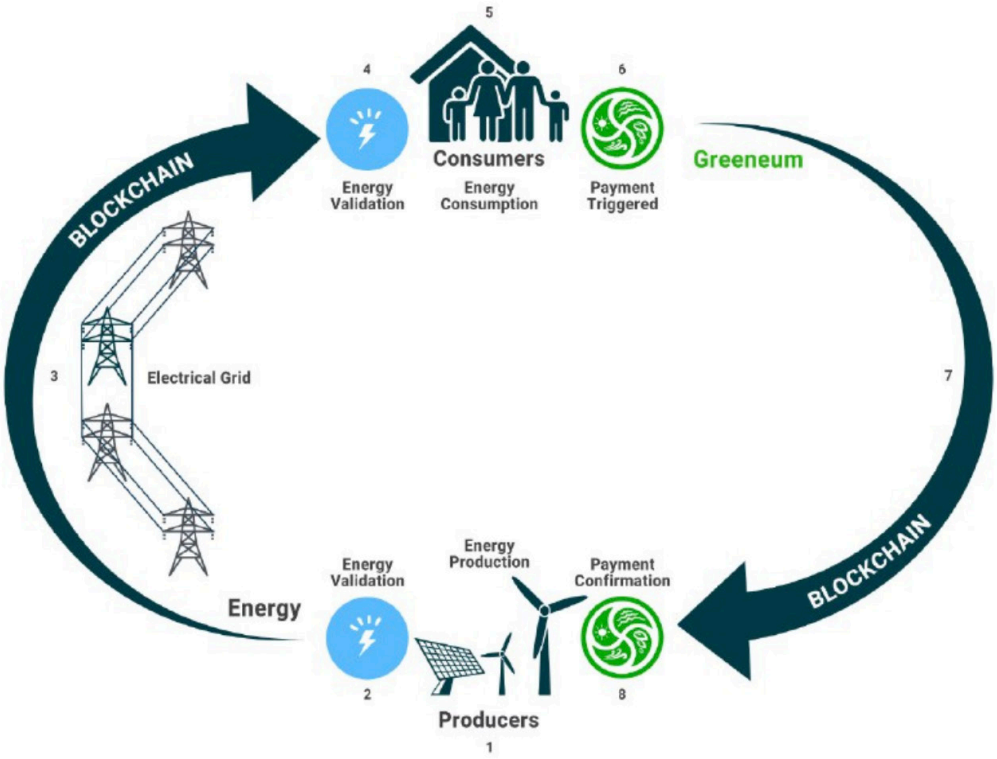

Figure 12: Flow diagram of p2p energy trading (production and consumption processes).

4.4.3. Additional energy trading models

In addition to the energy trading system described above, two additional energy

trading models are possible on the GREENEUM energy trading platform.

- **Commercial energy trading**
  Energy trading between end users consumers, and producers has been fully described. Energy companies also trade energy among themselves. The GREENEUM energy trading system enables such trading as well, where the specific contracts and trading models will be defined and adjusted according to the specific cases and needs.

- **Personal P2P energy trading**
  The general GREENEUM P2P energy system is a community contract between all participating members on the same electrical grid. Consumers are getting GREEN electricity continuously without any extra effort and producers are selling their energy without having to look for a specific buyer. In addition to that, the GREENEUM system enables a personal and confidential contract between specific consumers and producers selecting each other from the network. The details of the contract as duration and prices will be determined between the two parties. More implementational notes will be available in the future.

4.4.4. Demand Response

Demand response is a temporary measure to meet grid peaking capacity requirements. Purchasing peaking power can be expensive on the wholesale market to satisfy demand. Lately, utilities are seeking to automate demand response processes and offer their industrial, commercial and residential customers value-added services within their demand-side management programs.

Since demand response is a form of power generation, it can be used as a cost-effective way to reduce the need to purchase expensive wholesale power from inefficient forms of peaking generation.

Utilities are also increasingly relying on demand response tools, such as the Siemens Demand Response Management System (DRMS), for their cost-effectiveness and relatively short implementation times.

4.5. Mathematical Overview

Energy optimization problems are often-due to their underlying technical and physical processes-nonlinear and nonconvex, and some of the control decisions are of discrete nature. An appropriate mathematical modelling leads to large mixed-

integer nonconvex problems which usually cannot be solved by standard solvers. Uncertainty regarding supply and demand is another challenge that has to be taken into account. For foresighted decision support we develop forecast models for supply and demands. Moreover, the behavior of other market participants may also have an impact. Therefore, models feature both stochastic and game-theoretic components.

In this section we introduce the mathematical calculations for the energy trading flow.

Energy trading is done per the local electrical grid. Total transmitted and consumed energy are calculated periodically for the specific grid, and includes the total volumes of all GREENEUM users on that grid.

4.5.1. Producers payment

The periodic payment for the producer is a function of the electricity transmitted to the grid, the type of energy, and the times of transmission, where every energy type has different market prices in different hours. Without loss of generality, we refer to the higher resolution of continuous data, where the transmission can be constant over periods of time, when the data resolution is lower.

For Grid G, such that Producer P is connected to grid G:

$$P.Epay[period] = \int_{period} P.Eamount(t) * G.Eprice(type, t)dt \quad (3)$$

Where $type$ is the energy type produced by the producer. We assume here for simplicity that each producer produces a single type of energy, if this is not the case, a sum over the different types is applied to the equation.

4.5.2. Consumer payment

The periodic payment to be payed by the consumers is calculated based on their own consumption during the period $C.Eamount(t)$ and the total production on the grid for that period. Since different energy types have different prices in different times, the relative amounts are needed.

Total production on grid G, for time t, per energy type

$$G.Eamount(type, t) = \sum_{P||P \in G, P.Etype=type} P.Eamount(t) \quad (4)$$

We assume that the total production of GREENEUM users equal the total consumption of GREENEUM users, where Grid operator serves as a producer or consumer in the case of inequalities. So that $G.Eamount(type, t)$ is also the total consumption of energy of that type for that time.

The entire electricity in the grid for time t is then given by

$$G.Eamount(t) = \sum_{types} G.Eamount(type, t) \quad (5)$$

Where the sum is over the different energy types.

And the amount for each consumer for a specific type is calculated evenly by the proportion of that type in the grid for that time

$$C.Eamount(type, t) = \frac{G.Eamount(type, t)}{G.Eamount(t)} * C.Eamount(t) \quad (6)$$

The consumer payment equation for period is then

$$C.Epay[period] = \sum_{types} [\int_{period} C.Eamount(type, t) * G.Eprice(type, t)dt] \quad (7)$$

With this we generate a report for each consumer, with details about the periodic consumption cut to different energy types used over the period, with the average relative payments.

5. GREENEUM Team

The co-founders of Greeneum (greeneum.net) are also the co-founders of SolarChange (solarchange.co) but these are two independent projects that complete and support each other.

GREENEUM team, mentors and advisors are a collection of experts in a variety of areas such as smart contracts and Solidity, different Blockchain environments, IOT for renewable energy engineering, data science, machine learning and AI.

GREENEUM team welcomes to the Network all community members to support and benefit from our mission. The development activities and communication channels will be managed from Telegram and GREENEUM website. All three cofounders are experienced and passionate entrepreneurs.

- Assaf (CEO) and Elya (CTO) are both PhD Cand. and MSc. EE.and have over 10 years each in the biotech and software and high tech sector. They have been working in few start-ups (TimeBride, CritiSence, SAP, etc.), occupying various technological and managerial positions. Assaf is an expert in renewable and solar energy physics and systems and Elya is also an expert in machine learning, big data and signal analysis and encryption.

- Yau started programming professionally as a teenager, and has accumulated an impressive curriculum as a project and R&D manager. He's currently working at a promising new startup.

- Dmitry is an experienced project manager who has worked extensively in blockchain, web and mobile technologies. He leads a team of two developers in backend development. Dmitry and his team are located in the Ukraine, but despite the distance, he is very much involved in our operations.

- Bradley Boldt has a BS in Electrical Engineering from Purdue University and an MBA with a focus on strategy from The Ohio State University. He has worked in various roles in Power Generation and conversion for industrial markets for over 9 years while learning about various blockchain related projects in his free time. Brad is our COO, based out of the United States and is responsible for the Operational, Engineering and Accounting departments.

- Bradley Hook has over 10 years of management experience and runs a consulting company that focuses on implementing social and environmental impact. Bradley brings his team of marketing and business development professionals to accelerate GREENEUM's growth.

- United States GREENEUM team has expanded operations with friends,

supporters and contributors across the nation in major cities like New York, SF Bay Area and Los Angeles

All of GREENEUM's team members who are listed below are passionate in renewable energy and blockchain technologies. Our advisory board and team of experts include known Blockchain experts and leaders, such as the team at wings.ai, Virtual Growth and more. During this time, we have developed and tested some of the product, learned to integrate and validate energy data and worked with key players from the energy space. New experts and supporters are joining to our team and updated list can be found in website (greeneum.net). Full bios can be found also in Linkedin or given by request.

Assaf Ben-Or

Founder & CEO
Greeneum & SolarChange
PhD Cand. & EE. in Solar Energy

Elya Dolev

Co-Founder & CTO

Bradley Hook

COO

Edward Gorbis

Director of Business Development

Yau Ben-Or

Co-Founder

Rodrigo Rapoport

Director of Projects

Kevin Hung

Blockchain Software Engineer

Albert Bareli

CEO Seagon

Guillermo Wajner

Business Development and Digital Marketing

Nadya Suleymanova

Senior Softwarre Developer

Tom Budd

Business Development Sales

Dmitry Tatievskyi

Software development team manager

Phillip Inberg

Principle Advisor Empirical pi

Michael Terpin

Founder and CEO Coin Agenda

Mike Green

Solar Engineer

Karthik Lyer

Business Development
India & Asia

Dr Kyriacos Pavlou

Blockchain Smart-
Contracts Expert

Dr Theodosis
Mourouzis

Blockchain Smart-
Contracts Expert

Aki Baravalle

Renewable Energy
Business Development _
SCADA Guardian Senior
Clean Energy Advisor.
Symtech Solar Argentina

Martin A Bayugar

Founder and Executive
Chairman en Latin
Renewables

6. GREENEUM TOKENS and CROWDFUNDING

GREENEUM plans to launch the platform followed by an initial token offering process (ICO). Contributors can purchase GREENEUM tokens and support the development and deployment of GREENEUM platform. The details about the ICO tokens distribution and funds usage is detailed in this chapter.

6.1. GREENEUM Tokens

GREENEUM will issue GREEN tokens. A complete listing of the token allocation will be publicly available very soon.

GREENEUM will be an Ethereum-based token of utility and value. Tokens are a digital asset, bearing value by themselves based on their underlying assets, properties and/or rights. GREEN tokens are used to get access to the GREENEUM platform and purchase different services such as energy management, forecasting system, CO2 credits, GREEN certificates, etc. The token will allow global distributed trade for all energy stakeholders and will incentive the transition to renewable energy.

Ethereum was selected as the platform for the token as it enables us to easily create very complex systems with very little entry costs. Ethereum based tokens rely on the well-established Ethereum infrastructure, benefiting from accessibility:

- Security and predictability compared to building and running an independent blockchain network
- Use of robust and well supported clients (Ethereum- based token can be managed with official Ethereum clients)
- High liquidity (interchangeable with other Ethereum- based token or Ether)
- Easier listing on exchanges with infrastructure already in place
- Ethereum smart contracts enable a very transparent and secure way of profit sharing among the token holders.
- Machine learning and AI are integrated to reliably create, maintain and trade

energy and renewable data and for energy network optimization.

The team also understands that new blockchain technologies are coming out. We are in touch with developers on these projects and will be investigating new options as they arise. For example, should a new platform have more advantages for GREENEUM, it is possible in the future these could be used in place of the Ethereum network. This would of course be after much consideration, vetting and community input.

7. Summary

GREENEUM is a distributed and decentralised platform that contains different services for energy market stakeholders worldwide. GREENEUM leverages cutting edge disruptive technology, including blockchain and machine learning, to create an unparalleled reliable, comprehensive and potentially unlimited data and energy trading platform. GREENEUM technology is powering the energy market's transition from a centralized and non-renewable approach to a distributed and a sustainable model which will allow for continued economical and technological growth.

GREENEUM will work with leading energy information and monitoring partners on energy, protocols for data transmission, security, and integrity. Partners will be used to reach as many consumers as possible for the network. We are in discussions with partners at this time and will be releasing public notifications as details are finalized. Part of our strategy includes a business development team tasked with analyzing and penetrating the various world energy markets.

The GREENEUM token is used to get access to the GREENEUM network to trade for energy, data, products and services. Energy producers around the world will be more incentivized and could trade their energy P2P with consumers. Consumers, private, and public companies (or other entities) could reduce their carbon footprint using the GREENEUM certificate system.

GREENEUM's architecture and design is not only global, anonymous, and secure but also can be customised to different markets and use cases. Therefore, the GREENEUM solution can overcome regulation issues, price fluctuations and security issues to create a more stable energy market. GREENEUM is the ultimate global answer to energy security issues in the age where cyber attacks can completely paralyze a market or a country.

Utility companies, grid operators, and users alike can obtain real time energy tracking while global trade markets can benefit from such accurate and real time data. Smart predictions, insights and forecasts will be taken to a new level with our proprietary technology.

GREENEUM has a global GREEN community that is acting to create a clean energy market, a global GREEN community, a global energy data platform, energy market distribution and democracy energy security and pseudonymity. Ultimately, through the GREENEUM platform, stakeholders in the energy marketplace will be able to drive efficiencies, save millions and impact the global renewable energy marketplace.

Future usability of the GREENEUM network for the different needs in the energy market will be published at the media channels and coming white papers of GREENEUM Network.

We invite everyone interested in helping with this project to get involved on our Telegram chat or social media. In the coming days we will be releasing more detailed information regarding our token sale and advise everyone to stay posted for updates.

Nature and our planet ecological systems have no borders, walls, or Visas. Not only are our economical systems highly dependent on each other but we share the same nature resources, breath the same air, enjoy the same Sun, drink from same water, and eat from the same soil.

GREENEUM develops a sustainable ecosystem that will guarantee future generations will have the resources they need and human society has the tools to coexist with our environment.

GREENEUM is suggesting a GREEN revolution using the BlockChain technology and financial drive — for the first time that its makes total sense for all of us to go GREEN!

8. List of Figures

9. List of Tables

10. References

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Appendix

Appendix A1.

CO2 emissions from fossil fuels exists in different state of matter and cement production as shown in **Figure A1**.

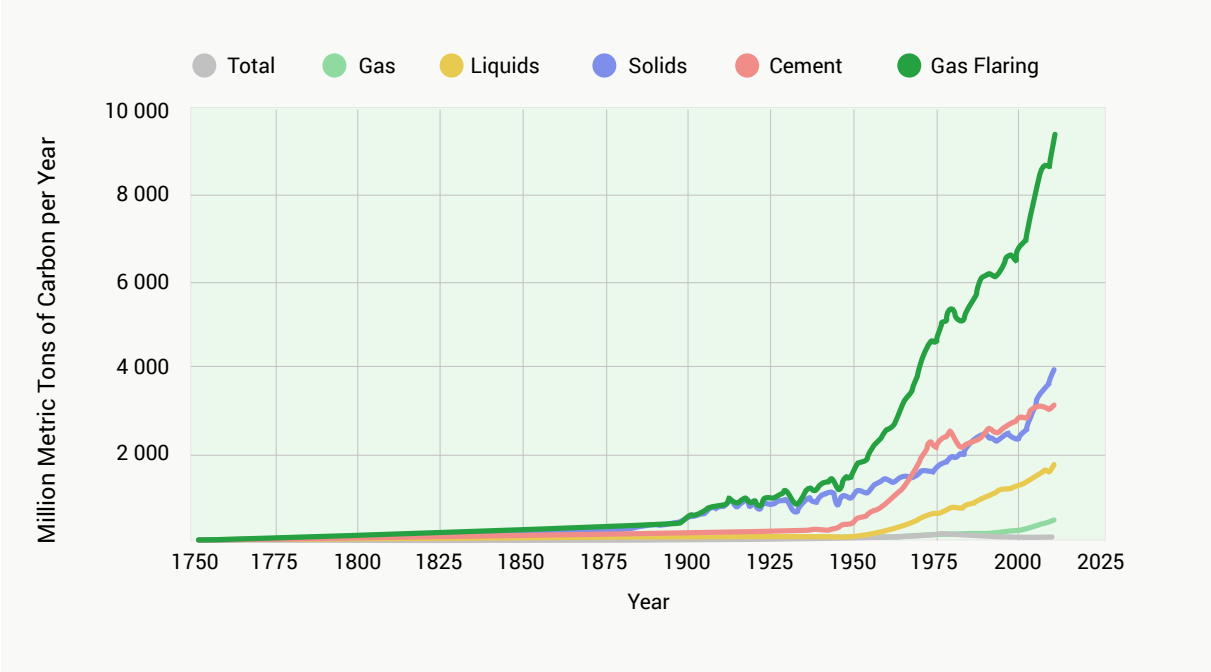


Figure A1: Total and individual contributors of CO2 emissions.

Appendix A2.

Making America GREEN Again!

A paper titled 100% Clean and Renewable Wind, Water and Sunlight all-sector Roadmaps for the 50 United States[14] suggests this is possible even within 35 years. This analysis shows that getting to 100% renewable energy within the US would consist of:

To further enhance these numbers, The Solutions Project website shows what each jurisdiction needs to do to get to 100%. For example, Minnesota could get 60% of its total energy from onshore wind (and note that this is all energy, not just electricity, but relies on electrification of transport). California, on the other hand, can get 26.5% from solar PV plants and 25% from onshore wind.

GREENEUM will accelerate these forecasted trends in the energy market by adding financial rewarding to efficient, transparent and GREEN behavior.

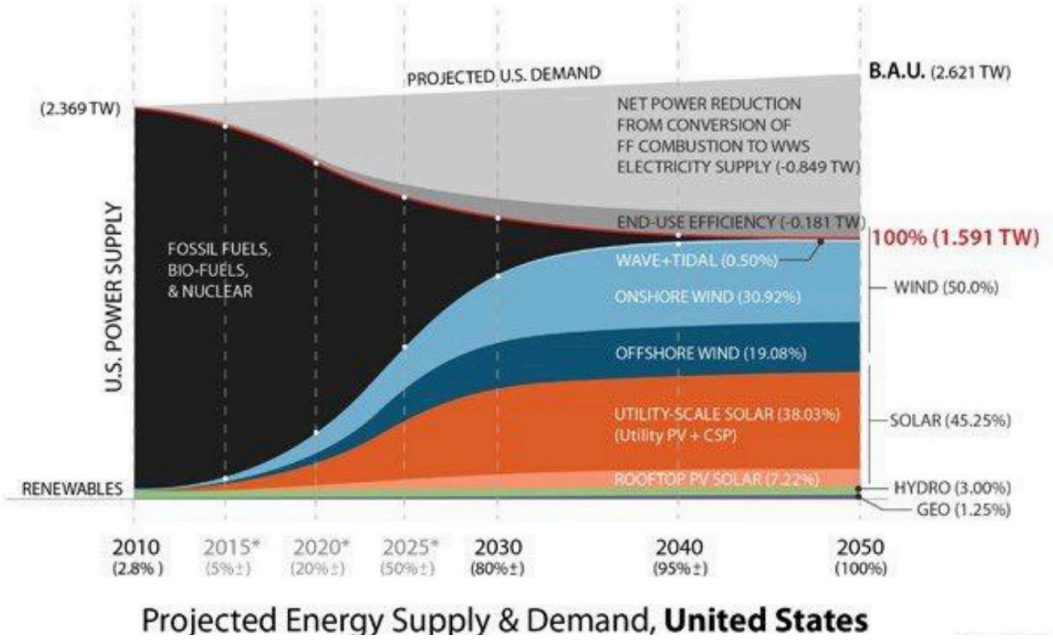
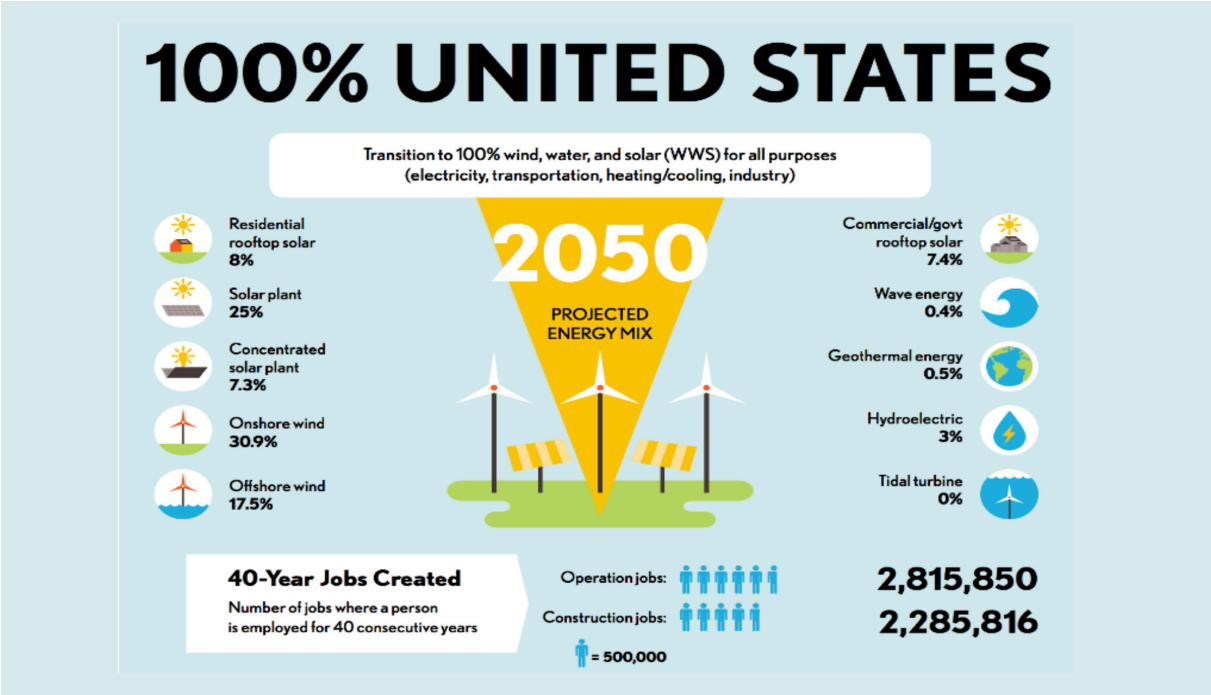


Figure A2: Energy Trends in the California (Top) and 100% GREEN USA scenario (Bot).

14 https://web.stanford.edu/group/efmh/jacobson/Articles/I/USStatesWWS.pdf



Under a 100% renewable scenario based on these numbers, millions of jobs would be created. Consider that 3.9 million construction jobs and 2 million operational jobs at renewable energy plants would outpace 3.9 million jobs lost from the traditional energy sectors.

30.9% onshore wind

19.1% offshore wind

30.7% utility-scale solar photovoltaics (PV)

7.2% rooftop PV

7.3% concentrated solar power (CSP) with storage

1.25% geothermal

0.37% tidal/wave

3.01% hydroelectricity

Appendix B: Detailed proposed procedure of Data and Energy Transaction on the GREENEUM Network. Note that actual trading of energy is subject to local regulations and will not be available to all jurisdictions until regulations are updated. GREEN incentive and Data trading will be available globally unless prohibited.

B.1.1. Data Transaction Reporting Production/Consumption:

1. Produced/Consumed electricity data is sent to GREENEUM global blockchain for validation.

2. If validation is accepted:

    a. Sender receives GREENEUM Data Bounty for publishing their energy data.

    b. If validated as GREEN the producer receives GREENEUM CERTIFICATES, which can be traded for GREEN tokens.

    c. Validators pay GREENEUM validation fee.

3. If validation rejected:

    a. System/account is being checked.

    b. Validators receives GREENEUM validation fee.

B.1.2. Collecting Production Data

There are several ways for data to be collected, each with different time resolution and accuracy confidence, and each will receive a varying GREENEUM data bounty. The main three levels are:

1. System registration - with proved parameters of Address, Type, Capacity.
   In this level production is estimated and payments are the lowest.

2. Inverter data - according to device.
   This is near realtime true production values and rewarded higher.

3. GREENEUM IoT - recording additional live environmental parameters.
   This level has highest confidence and data resolution and will grant maximum GREENEUM tokens.

B.1.3. Collecting Consumption Data

There are several ways for data to be collected, each with different time resolution and accuracy confidence. The main three levels are:

Monthly bill - with lowest resolution and lowest GREENEUM payments.

Smart meter - enabling consumer rewards for smart energy decisions, see Rewarding NegaWatts section

GREENEUM IoT - enabling energy data and bounties for energy information

B.2.1. Energy Consumption Transaction

1. Electricity is consumed from the electrical grid.
2. Consumed electricity is sent to the Blockchain consumption smart contract for validation.
3. If validation is accepted:
    a. Consumer pays GREENEUM electricity payment for the electricity.
    b. Consumer receives the GREENEUM Certificate profiling different types of energy usage and gain GREENEUM carbon credits.
    c. Utility receives GREENEUM distribution and service fee.
    d. Validators receives GREENEUM tx fee.
4. If validation is rejected:
5. Consumer's account is being checked.
6. Validators receives GREENEUM tx fee.

B.2.2. Energy Production Transaction

1. Electricity produced on the energy grid

2. Produced electricity data is sent to the blockchain for validation.

3. If validation is accepted:

    a. Producer receives GREENEUM electricity payment for the electricity.

    b. Producer receives GREENEUM Data Bounty for publishing the data.

    c. If validated accepted as GREEN - Producer receives GREENEUM payment for their certified GREEN energy, and a copy of the GREENEUM Certificate, which was sold to the consumers.

    d. Utility receives GREENEUM distribution and service fee.

    e. Validators receives GREENEUM validation fee.

4. If validation is rejected:

    a. Producer's system is being checked.

    b. Validators receives GREENEUM validation fee.

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Sustainable development is the pathway to the future we want for all. It offers a framework to generate economic growth, achieve social justice, exercise environmental stewardship and strengthen governance

Ban Ki-moon

greeneum

Powering the internet of Energy

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